Express Mail Label No.: EL5453L2276US 03/30/00

NEW UTILITY PATENT APPLICATION TRANSMITTAL (Large Entity) *(Only for new nonprovisional applications under 37 C.F.R. 1.53(b))*	Docket No. A39.2-8766
	Total Pages in this Submission *(including checks and postcard)*

jc600 U.S. PTO 03/30/00

jc678 U.S. PTO 09/538785 03/30/00

Box Patent Application
Assistant Commissioner for Patents
Washington, D.C. 20231

Transmitted herewith for filing under 35 U.S.C. 111(a) and 37 C.F.R. 1.53(b) is a new utility patent application for an invention entitled: MAGNETICALLY SENSED SECOND ENVIRONMENT SAFETY AND ARMING DEVICE

and invented by: Kenneth D. Ceola

If a CONTINUATION APPLICATION, *check appropriate box and supply the requisite information:*
☐ **Continuation** ☐ **Divisional** ☐ **Continuation-in-part (CIP)** of prior application No.: __

Enclosed (in addition to the 4 pages of this transmittal) are: **4 pages**

Application Elements

1. ☒ **Filing fee as calculated below:**
   a. ☐ **filing fee is NOT ENCLOSED - fee will be paid at the time of responding to the Notice of Missing Parts -- DO NOT CHARGE DEPOSIT ACCOUNT**
   b. ☒ **a check in the amount of $** 690.00 **to cover the filing fee is enclosed.** ___ **pages**
   c. ☐ **charge to Deposit Account as authorized at Item 2(a) on next page.**

FEE CALCULATION AND C L A I M S					
For	**No. Filed**	**No. Allowed**	**No. Extra**	**Rate**	**Fee**
Total Claims	14	- 20 =		x $18.00	$
Indep. Claims	2	- 3 =		x $78.00	$
				BASIC FEE	$690.00
				TOTAL FILING FEE	$ 690.00

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	Total Pages in this Submission *(including checks and postcard)*

continued on next page.....

2. **The Commissioner is hereby authorized to charge and credit Deposit Account No. 22-0350 as described below. A duplicate copy of this sheet is enclosed.**
   - a. ☐ **Charge the amount of $____ as filing fee.**
   - b. ☐ **Credit any overpayment.**
   - c. ☐ **Charge any additional filing fees required under 37 C.F.R. 1.16 and 1.17.**
   - d. ☐ **Charge the issue fee set in 37 C.F.R. 1.18 at the mailing of the Notice of Allowance, pursuant to 37 C.F.R. 1.311(b).**

3. ☒ Specification having __8__ pages and including the following: _8__ pages
   - a. ☒ Application Cover Sheet - 1 page
   - b. ☒ Descriptive Title of the Invention -
   - c. ☐ Cross References to Related Applications *(if applicable)*
   - d. ☐ Statement Regarding Federally-sponsored Research/Development *(if applicable)*
   - e. ☐ Reference to Microfiche Appendix *(if applicable)*
   - f. ☒ Background of the Invention
   - g. ☒ Brief Summary of the Invention
   - h. ☒ Brief Description of the Drawings *(if applicable)*
   - i. ☒ Detailed Description
   - j. ☒ Claim(s) as Classified Below - __2___ pages
   - k. ☒ Abstract of the Disclosure -1 page

4. ☒ Drawing(s) *(when necessary as prescribed by 35 U.S.C. 113)* __1__ sheets __1_ pages

5. ☒ Oath or Declaration - __3_ pages
   - a. ☐ Newly executed *(original or copy)* ☐ Unexecuted
   - b. ☐ Copy from a prior application (37 C.F.R. 1.63(d)) *(for continuation/divisional application only)*

6. ☒ Separate Power of Attorney _1__ pages

   ☐ 37 C.F.R. 3.73(B) Statement *(when there is an assignee and power of attorney is from assignee).* It is hereby certified that the undersigned has authority to make this certification and has reviewed all the documents in the chain of title of the patent application identified herein and, to the best of undersigned's knowledge and belief, title is in the assignee

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identified in the accompanying Power of Attorney.

☐ Power of Attorney filed in parent application.

7. ☐ Incorporation by Reference *(usable if Box 5b is checked)*
The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 5b, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.

8. ☐ Computer Program in Microfiche *(Appendix)* ___ pages

9. ☐ Nucleotide and/or Amino Acid Sequence Submission ___ pages
(if applicable, all must be included)
   a. ☐ Paper Copy
   b. ☐ Computer Readable Copy *(identical to computer copy)*
   c. ☐ Statement Verifying Identical Paper and Computer Readable Copy

Accompanying Application Parts

10. ☒ Assignment Papers: _3__ pages
   a. ☒ Assignment Recordation Cover Sheet (Form PTO 1595)
   b. ☒ Assignment
   c. ☒ A check in the amount of $ 40.00 to cover the Recordal Fee
   d. ☐ Previously recorded on_____, Reel *, Frame *

11. ☐ English Translation Document *(if applicable)* ___ pages

12. ☐ Information Disclosure Statement: ___ pages
   a. ☐ PTO Form 1449 b. ☐ Copies of IDS Citations

13. ☐ Preliminary Amendment ___ pages

14. ☒ Acknowledgement Postcard 1 page

15. ☒ Form of Mailing - Express Mail *(Specify Label No.)*: EL545312276US

Express Mail Label No.: EL5453L2276US

NEW UTILITY PATENT APPLICATION TRANSMITTAL (Large Entity) *(Only for new nonprovisional applications under 37 C.F.R. 1.53(b))*	Docket No. A39.2-8766
	Total Pages in this Submission *(including checks and postcard)*

16. ☐ Certified Copy of Priority Document(s) *(if foreign priority is claimed)* ___ pages

17. ☒ Additional Enclosures *(please identify below)*: 2 pages
- ☒ Constructive Petition for Extension of Time and Fee Authorization Pursuant to 37 C.F.R. §1.136(a)(3) - 1 page
- ☒ Correspondence Address form.
- ☐ _____

Respectfully submitted,

VIDAS, ARRETT & STEINKRAUS

Date: 3/30/2000

By: _____
RICHARD A. ARRETT, ESQ.
Registration No.33,153

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F:\WPWORK\RAA\8766-TRA.330

DOCKET NO.:A39.2-8766

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
APPLICATION FOR UNITED STATES LETTERS PATENT

INVENTORS: Kenneth D. Ceola

TITLE: **Magnetically Sensed Second Environment Safety And Arming Device**

ATTORNEYS: Richard A. Arrett
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Magnetically Sensed Second Environment Safety And Arming Device

CROSS-REFERENCE TO RELATED APPLICATIONS

Not Applicable

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH

Not Applicable

BACKGROUND OF THE INVENTION

This invention relates to safety and arming devices for use with fuzes and more particularly, to a magnetic sensor which senses muzzle exit, spin rate and count turns.

A safety and arming device is a required element of a munition to ensure that the munition is not armed and detonated until the desired time. The safety and arming device (S & A) is part of a munition's fuze and prevents arming of the fuze until certain conditions are met.

MIL-STD-1316 requires two unique environments or occurrences for fuze arming. The first environment utilized is usually setback for gunfired munition fuzing. Setback acceleration of gunfired munitions, due to its large magnitude, is an easily mechanically sensed environment. Fuze power is frequently not available at setback necessitating a mechanical environment sensor. Effective mechanically sensed second environments are much more difficult as set forward and spin, for example, can be relatively low, difficult to mechanically sense, and not sufficiently unique to gunfire to provide adequate safety. A second environment, electrically sensed, such timing, barrel escape or turns counting can be used to increase safety and satisfy MIL-STD-1316.

Many different setback determination devices exist, such as US 5693,906, entitled "Electro-Mechanical Safety And Arming Device", which is commonly owned with this application. Muzzle exit determination and turns counting is also provided in many prior art devices, such as US 5497704, entitled "Multifunctional Magnetic Fuze", which is also commonly owned with this application. The entire contents of these references are hereby incorporated by reference.

There is always a need to make the safety and arming devices of any device utilizing a fuze as safe as possible.

BRIEF SUMMARY OF THE INVENTION

The present invention provides a safer safety and arming device which utilizes a magnetic sensor to determine two or more events, such as muzzle exit, spin rate, and count turns, and also ensures that the determined events occur in the correct order and at the expected time. The magnetic sensor data may also be combined with other events, such as setback to substantially increase the safety of gunfired fuze systems.

These and other advantages and features which characterize the invention are pointed out with particularity in the claims annexed hereto and forming a part hereof. However, for a better understanding of the invention, its advantages and objectives obtained by its use, reference should be made to the drawings which form a further part hereof and the accompanying descriptive matter, in which there is illustrated and described a preferred embodiment to the invention.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

Referring to the Drawings, wherein like numerals represent like parts throughout the several views:

Figure 1 is a block diagram of the safety and arming apparatus of the invention.

DETAILED DESCRIPTION OF THE INVENTION

While this invention may be embodied in many different forms, there are described in detail herein specific preferred embodiments of the invention. This description is an exemplification of the principles of the invention and is not intended to limit the invention to the particular embodiments illustrated.

The safety and arming apparatus is shown generally at 10 in FIG. 1 and includes a magnetic sensor 12, a setback switch 14, a timing device 16, a muzzle exit signal

processing block 18, a spin rate signal processing block 20 and a turns counting signal processing block 22. The timer is started upon the occurrence of setback, which may be determined by any known setback determination device, although the device of US 5693906 is preferred. In cases where power is not available at setback (i.e. the battery is setback activated), battery rise to a specific value can be assumed as the setback time mark. The timer is output to both the muzzle exit and spin rate signal processing blocks 18 and 20. The muzzle exit signal processing block outputs a "1" to AND gate 26 only if muzzle exit is detected within a predetermined time window, based on the timer 16, which is only started upon setback. Muzzle exit is determined in accordance with the teachings of US 5497704 by detecting the magnetically induced signature of the projectile as it leaves the ferrous confinement of the barrel and enters the earth's magnetic field. If the Muzzle exit signature is not detected within the expected window, a "1" signal to OR gate 24 will result in a dud.

The output of the spin rate signal processing block 22 is input to both a dud OR gate 24 and an AND gate 26. The spin rate signal processing block outputs a "1" to AND gate 26 only if the spin rate is between a predetermined minimum and maximum spin rate within a predetermined time window, based on the timer 16. If the spin rate signature is not detected within the expected window, a "1" signal to OR gate 24 will result in a dud. Both the muzzle exit and spin signal must occur within the expected time window to result in an arm enable signal from AND gate 26 to AND gate 28.

The output of the turns count signal processing block 22 is output to AND gate 28 and is enabled or set to "1" only after a predetermined number of turns of the projectile are detected with magnetic sensor 12. Only if both the output of 26 and the turns count 22 are "1" will the arm signal be set to "1" to cause the fuze to be armed, but only if the Dud signal is "0".

While not specifically detailed, it will be understood that the various electronic functional blocks are properly connected to appropriate bias and reference supplies so as to operate in their intended manner. It should also be understood that the processing described herein utilizes well known technology. Further, any circuitry configurations and applications thereof other than as described herein can be configured

within the spirit and intent of this invention.

The above Examples and disclosure are intended to be illustrative and not exhaustive. These examples and description will suggest many variations and alternatives to one of ordinary skill in this art. All these alternatives and variations are intended to be included within the scope of the attached claims. Those familiar with the art may recognize other equivalents to the specific embodiments described herein which equivalents are also intended to be encompassed by the claims attached hereto.

What is claimed is:

1. A safety and arming apparatus for use with a projectile, comprising:

a magnetic sensing apparatus for determining the occurrence of at least two of the events selected from the group consisting of muzzle exit, a predetermined spin rate, and a predetermined number of turns,

whereby upon the occurrence of the at least two events the fuze is armed.

2. The safety and arming apparatus of claim 1 further including a timer and wherein the magnetic sensing apparatus is programmed to arm the fuze only if the at least two events occur in a predetermined order in a predetermined time window.

3. The safety and arming apparatus of claim 1 wherein the at least two events are muzzle exit, spin rate, and turns in a predetermined time window.

4. The safety and arming apparatus of claim 1 wherein the at least two events are muzzle exit and a predetermined number of turns.

5. The safety and arming apparatus of claim 1 wherein the at least two events are a predetermined spin rate and a predetermined number of turns.

6. The safety and arming apparatus of claim 1 wherein the at least two events are muzzle exit, a predetermined spin rate, and a predetermined number of turns.

7. The safety and arming apparatus of claim 2 further including a setback sensor and wherein the fuze is armed only if setback occurs and the at least two events occur in a predetermined order.

8. The safety and arming apparatus of claim 7 wherein the fuze is armed only if muzzle exit occurs within a predetermined time window from when setback occurs.

9. The safety and arming apparatus of claim 1 wherein the fuze is armed only if the spin rate is between a predetermined minimum and maximum spin rate within a predetermined time window.

10. A method for safing and arming a projectile, the steps comprising:

a) determining the occurrence of at least two of the events selected from the group consisting of muzzle exit, a predetermined spin rate, and a predetermined number of

turns,

b) arming the fuze.

11. The method of claim 10 further including the step of arming the fuze only if a setback event occurs.

12. The method of claim 11 further including the step of arming the fuze only if the event of muzzle exit occurs within a predetermined time from when setback occurs.

13. The method of claim 12 further including the step of arming the fuze only if the spin rate is between a predetermined minimum and maximum spin rate.

14. The method of claim 13 further including the step of arming the fuze only after the projectile has turned a predetermined number of turns.

ABSTRACT OF THE DISCLOSURE

Magnetically Sensed Second Environment Safety And Arming Device

The fuze is armed only if muzzle exit is sensed by a magnetic sensor within a predetermined time after setback is sensed and either one or both of a minimum spin rate is sensed by the magnetic sensor and/or a minimum number of turns are counted.

2. Description of invention with reference to drawings, where applica., including materials or ingredients and mode of operation or method of preparation and with examples, if applicable. If more space is required, use continuation sheets provided. (Continued)

An example of applying these environments can be used to enhance system safety is shown below:

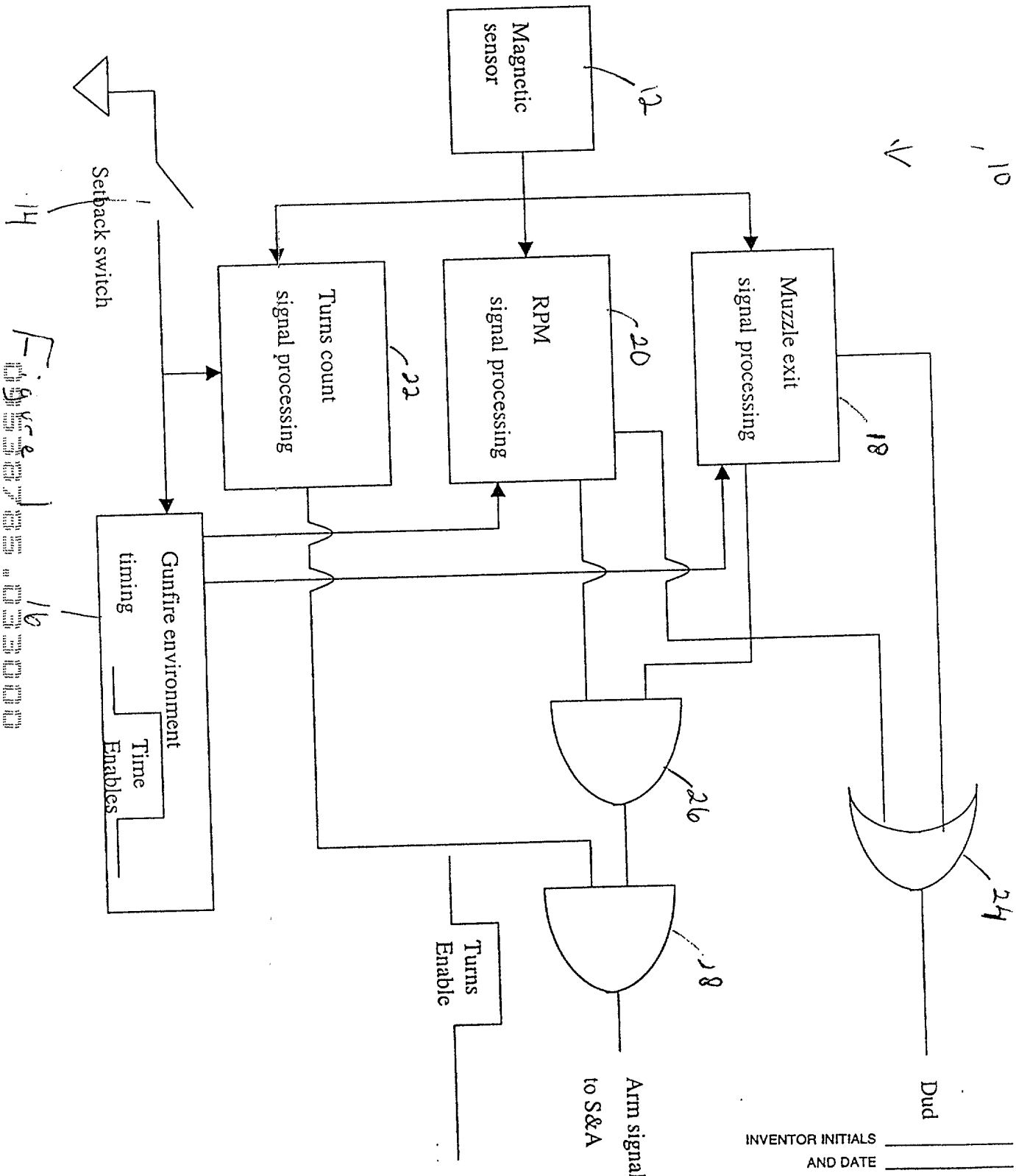

Figure 1

INVENTOR INITIALS _____
AND DATE _____

UTILITY/DESIGN PATENT
Docket No. **A39.2-8766**

DECLARATION

As a below-named inventor, I(we) hereby declare that:

TYPE OF DECLARATION

This declaration is of the following type:

- ☒ original
- ☐ design
- ☐ supplemental
- ☐ national stage of PCT
- ☐ divisional
- ☐ continuation
- ☐ continuation-in-part (CIP)

INVENTORSHIP DECLARATION

My residence, post office address, and citizenship are as stated below next to my name;

I verily believe I am the original, first and sole inventor *(if only one name is listed below)* or an original, first and joint inventor *(if plural names are listed below)* of the subject matter which is claimed and for which a patent is sought on the invention entitled:

MAGNETICALLY SENSED SECOND ENVIRONMENT SAFETY AND ARMING DEVICE

the specification of which:

a) ☒ is being filed concurrently herewith
b) ☐ was filed on _____ and assigned Serial No. _____
c) ☐ was filed as PCT International Application No. _____ filed on _____ and amended under PCT Article 19 on _____.

ACKNOWLEDGMENT OF REVIEW OF PAPERS AND DUTY OF CANDOR

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations §1.56 including information occurring between the filing date of any prior application of which the present application is a continuation-in-part.

☐ In compliance with this duty there is attached an Information Disclosure Statement. 37 CFR 1.97.

PRIORITY CLAIM

I hereby claim foreign priority benefits under Title 35, United States Code, §119(a)-(d), of any foreign application(s) for patent or inventor's certificate or of any PCT international applications(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application for patent or inventor's certificate or any PCT international applications(s) designating at least one country other than the United States of America filed by me having the same subject matter having a filing date before that of the application on which priority is claimed.

a) ☒ no such applications have been filed.
b) ☐ such applications have been filed as follows:

COUNTRY	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 37 USC 119
			☐ YES ☐ NO
			☐ YES ☐ NO
			☐ YES ☐ NO
			☐ YES ☐ NO

I hereby claim the benefit under Title 35 United States Code, §119(e) of any United States provisional application identified below.

a) ☒ no such applications have been filed.
b) ☐ such applications have been filed as follows:

U.S. APPLICATIONS	
SERIAL NUMBER	U.S. FILING DATE
1.	
2.	

CLAIM FOR BENEFIT OF EARLIER U.S./PCT APPLICATIONS(S) UNDER 35 U.S.C. §120

I hereby claim the benefit under Title 35, United States Code, §120 of any United States applications(s) or PCT international applications(s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior applications(s) in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56 which occurred between the filing date of the prior applications(s) and the national or PCT international filing date of this application.

a) ☒ no such applications have been filed.
b) ☐ such applications have been filed as follows:

U.S. APPLICATIONS	
SERIAL NUMBER	U.S. FILING DATE
1.	
2.	
PCT APPLICATIONS DESIGNATING THE U.S.	
PCT APPLICATION NO.	PCT FILING DATE
3.	

I hereby declare that all statements made herein of my knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Telephone calls and correspondence should be directed to: Richard A. Arrett, at Customer No. 490, Telephone: (612) 563-3000, Facsimile: (612) 563-3001.

First Inventor		Second Inventor	
Full name:	Kenneth D. Ceola	Full name:	
Inventor's signature:	Kenneth D Ceola	Inventor's signature:	
Date:	3/30/00	Date:	
Citizenship:	US	Citizenship:	
Post office Address:	838 Haralson Drive Apple Valley, Minnesota 55124	Post office Address:	
Residence (If different than above)		Residence (If different than above)	

UTILITY/DESIGN PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s):	Kenneth D. Ceola	
Title:	MAGNETICALLY SENSED SECOND ENVIRONMENT SAFETY AND ARMING DEVICE	
Filed:	☒	concurrently herewith
	☐	on _____ and assigned Serial No. _____

Assistant Commissioner for Patents
Washington, DC 20231

Docket No: **A39.2-8766**

POWER OF ATTORNEY FROM ASSIGNEE

As assignee of record of the entire interest of the above identified patent application, **Alliant Techsystems Inc.** hereby appoint all practitioners of **Customer No. 490** to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith. I hereby authorize them to act and rely on instructions from, and to communicate directly with, the firm or person which sent this case to Vidas, Arrett & Steinkraus, P.A., unless or until I instruct Vidas, Arrett & Steinkraus P.A., in writing to the contrary.

Address all correspondence to **Richard A. Arrett** at Customer Number 490.

Dated this 30 day of March, 2000.

(Company Name) **Alliant Techsystems Inc.**

(Signature) By: _____

(typed name) Daryl L. Zimmer

(title) Its: Vice President & General Counsel

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s):	**Kenneth D. Ceola**
Title:	**MAGNETICALLY SENSED SECOND ENVIRONMENT SAFETY AND ARMING DEVICE**
Filed:	☐ concurrently herewith
	☐ on _____ and assigned Serial No. _____

Box Patent Application
Assistant Commissioner for Patents
Washington, D.C. 20231

Docket No.: **A39.2-8766**

CORRESPONDENCE ADDRESS OF LAW FIRM

Vidas, Arrett & Steinkraus P.A. would like to make the following correspondence address of record. Please send all correspondence for this application to the address as follows:

Vidas, Arrett & Steinkraus P.A.
Suite 2000
6109 Blue Circle Drive
Minnetonka, MN 55343-9131

Respectfully submitted,

VIDAS, ARRETT & STEINKRAUS

By: _____
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Registration No. 33,153

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Minnetonka, MN 55343-9131
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